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Physical and psychological response to exercise training in chronic kidney disease patients: A quasi-randomized controlled trial

Ahmed Abdelmoniem Ibrahim[1], **Omar W Althomali**[1], **Hisham M Hussein**[1,3], **Mohamed R Atyia**[1], **Mohamed T Eldesoky**[2,3], **Mervat Gamal**[4,5], **Walid Kamal Abdelbasset**[6,7]✉

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Author Affiliation:
[1]Department of Physical Therapy, College of Applied Medical Sciences, University of Ha'il, Ha'il, Saudi Arabia
[2]Department of Physical Therapy, College of Applied Medical Sciences, University of Tabuk, Tabuk, Saudi Arabia
[3]Department of Physical Therapy for Basic Sciences, Faculty of Physical Therapy, Cairo University, Giza, Egypt
[4]College of art, University of Ha'il, Ha'il, Saudi Arabia
[5]Department of Community Organization, Faculty of Social Work, Helwan University, Cairo, Egypt
[6]Department of Health and Rehabilitation Sciences, College of Applied Medical Sciences, Prince Sattam bin Abdulaziz University, Al Kharj, Saudi Arabia
[7]Department of Physical Therapy, Kasr Al-Aini Hospital, Cairo University, Giza, Egypt

✉**Corresponding author**
Department of Health and Rehabilitation Sciences, College of Applied Medical Sciences, Prince Sattam bin Abdulaziz University,
Al Kharj, Saudi Arabia;
Email: walidkamal.wr@gmail.com

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ABSTRACT

Chronic kidney disease is an important public and medical problem, as it is associated with high risks of complications which lead to a reduction in physical capacity, psychological status, and quality of life. This study aims to evaluate the impact of a 10-week exercise program, containing 30 minutes of moderate-intensity aerobic exercise training on physical capacity, psychological status, and quality of life in chronic kidney disease patients (CKD). This quasi-experimental study was applied for chronic kidney disease patients. Physical capacity, psychological status, and quality of life were assessed at baseline and after 10-weeks of aerobic training (cycle ergometer), it was performed three times per week for 10 weeks on alternate days with hemodialysis sessions. Thirty-two CKD patients (16 aerobic group) and (16 control group) with demographic data (age, p=0.313, sex, p=0.288, body mass index, p=0.825, CKD duration, p=0.689, and education levels, p>0.05) were evaluated pre and post 10 weeks of aerobic exercise training sessions; there was a significant improvement in the outcome measures of the aerobic group in (6-MWT, p=0.024, TUG-s, p<0.001, QOL-mental health, p=0.002, QOL-role functioning/ emotional, p=0.012, HAM-DRS, p<0.001, and HAM-ARS, p<0.001), while, no significant changes were detected in the control group. It was concluded that low-intensity aerobic exercise program has positive effects on the physical capacity, Psychological status and, life quality of patients with chronic kidney disease.

Keywords: Aerobic exercise; chronic kidney diseases; physical capacity; psychological status; quality of life

1. INTRODUCTION

Kidney disease is among the highest-stress illnesses worldwide due to its chronicity and the long-term of treatment, the patients suffer from its symptoms and disruption of his life as they spend long time during dialysis as long as they live. In the Arabic and gulf region the rate of renal diseases is high (Hassanien et al., 2012). The prevalence of chronic kidney diseases in the Kingdom of Saudi Arabia is increasing with higher rate of morbidity and mortality (Hawamdeh et al., 2016). However, the focus of research is mostly on the treatment of the kidney disease rather than the associated psychological, physical, and social problems facing these patients (Hawamdeh et al., 2016; Nahamin et al. 2020). It has been noted that chronic renal disease patients suffer from decreased physical health, depression and mental stress (Hedayati et al., 2008).

According to many studies, depression and anxiety were seen in chronic kidney disease (CKD) patients, it can be attributed to several factors that include the reaction to the diagnosis, the nature of the treatment and the effect of these long-term treatments, which could be compromised the quality of life, job loss, and financial burden to the patient and the family (Eghbali et al., 2009; Klaric & Klaric, 2012; Saeed et al., 2012). Depression among CKD patients complicates their illness; affects their compliance to treatment, and their ability to cope. The study done by Hedayati et al, (2008) showed that death is twice as likely among CKD patients with depression compared with those without depression (Hawamdeh et al., 2016). Several studies examining the relationship between psychosocial problems and chronic kidney disease has done in recent years, the investigation of the psychosocial part of nephrology patient is still moderately new and expects researchers should have to give significant research regard the nontraditional hazard factors which effect on CKD patients, for example, tension, stress, and social help (Cukor et al., 2008; Kimmel et al., 2008).

The relationship between social relations and kidney disease has not been pursued extensively. A few studies have analyzed the relationship between social support, depression, QOL, compliance, and survival rates among CKD patients, and they established that social help is controversially identified with mortality and morbidity risk. These studies showed the effectiveness of the positive social support that is considered a protective factor for individuals dealing with time-consuming, long-term therapy associated with CKD (Cohen et al., 2007). Within the health recommendations, it is advised to include regular physical activity from the initial stages of CKD patients, which will improve the physical and psychological conditions at the same time improve the quality of life (Roshanravan et al., 2017; Zelle et al., 2017). Exercise training as a therapeutic intervention, could decrease muscle weakness, maintain physical function, and improve quality of life in CKD patients (Watson et al., 2015).

Generally, previous studies approved that low intensity-aerobic exercise have beneficial effects on quality of sleep and depression status in heart failure patients (Abdelbasset & Osailan, 2020; Abdelbasset et al., 2019) and chronic obstructive pulmonary disease patients (Abdelbasset et al., 2020). It was reported also that aerobic exercises have positive effects in hepatic patients (Abdelbasset et al., 2020; Abdelbasset et al., 2019).

Several scientific studies have proved the benefits of exercise training activity for patients with chronic renal disease, such as increase of exercise tolerance, muscle strength, functional capacity, and life quality (Corrêa et al., 2009; Kosmadakis et al., 2010; Martins & Cesarino, 2005; Tentori, 2008). This aim of the current study is to evaluate the effects of moderate-intensity aerobic exercise training physical capacity, psychological status, and quality of life in chronic kidney disease patients (CKD).

2. MATERIALS & METHODS

This quasi-experimental study was conducted between (October 2020 and December 2020), to evaluate the impact of moderate intensity aerobic exercise training on physical capacity, psychological status, and quality of life in chronic kidney disease patients (CKD) on regular hemodialysis. Using two groups (aerobic exercise and control), pre-test and post-test design was employed to evaluate the effect of moderate intensity aerobic exercise for CKD patients. This study was approved by the local institutional Ethics Committee of Department of Physical Therapy (RHPT/020/0063).

Participants

32 CKD patients were included, allocated into two groups, aerobic group AG (n= 16) and control group CON (n=16). The flow diagram (according to CONSORT 2010) is shown in Figure 1 (Schulz et al., 2010), the aerobic group (AG)was assigned to aerobic exercise, and the control group (CG) was received usual care. For inclusion criteria, the patient was age over 40 years, make part of the hospital's hemodialysis program and sign an informed consent. Patients complaining of recent cardiac problems, hypertension, diabetes, and neuromuscular disorders were excluded from the study.

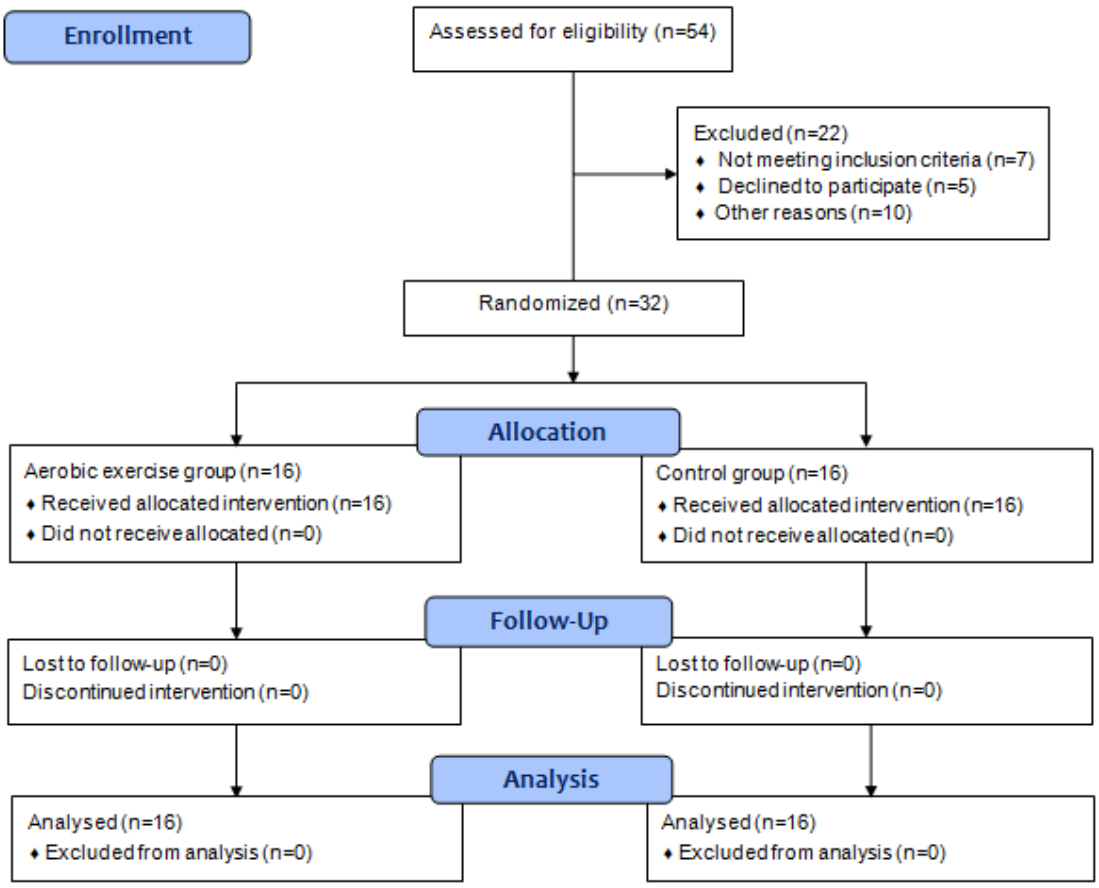

Figure 1 CONSORT 2010 flow diagram

Intervention

Exercise training for (aerobic group) was performed in the alternate days to hemodialysis sessions, three times per week for 10 weeks; it consisted of 30 minutes of moderate-intensity exercise, the warm-up was performed by active stretching of the lower and upper limbs, then the patient was submitted to aerobic training by bicycle ergometry with an initial duration of 20 minutes. The exercise intensity was controlled by measuring the patient's maximum heart rate (60 to 70% of maximum heart rate), the modified Borg Scale (beginning: 3 = moderate) was used as a measurement of patient exertion. The training program was completed by cool down using passive stretching of the lower limbs and upper limbs. Regarding to the Control group, no prescription of exercise regime but advised to maintaining their routine day activities for 10 weeks.

Initial assessment and Outcome measures

Patients in both groups (AG and CG) were assessed for Age (y), sex, body mass index (BMI, kg/m2), Duration of CKD (m), and Education level, on the first visit They also underwent the six-minute walk test (6MWT), TUG-s: time up & go test, HAM-DRS: Hamilton depression rating scale, HAM-ARS: Hamilton anxiety rating scale and were completed mental component domains of medical outcomes study short-form 36-item (SF-36) including mental health and Role functioning/emotional domains (Alhadi et al., 2018; Hallit et al., 2020; Hamilton, 1967; Ware Jr, 2000; Ware Jr & Sherbourne, 1992).

Statistical analysis

Demographic and clinical outcome measures were collected and checked for normal distribution using the Shapiro-Wilk test. Data were presented as means ± standard deviations (SD). Mann-Whitney U test and Chi-square test were used to assess the statistical difference between non-normally distributed data. While student's *t*-test was used to assess the statistical difference between the normally distributed data, paired t-test within each group pre-and post-intervention and unpaired t-test between groups pre- and

post-interventions. The SPSS for Windows v. 25 (IBM Corp., Armonk, NY, USA) was used for analyzing all collected data with statistical significance at $p<0.05$.

3. RESULTS

No statistical significance was observed between the aerobic and control groups pre-intervention regarding demographic data (age, $p=0.313$, sex, $p=0.288$, body mass index, $p=0.825$, CKD duration, $p=0.689$, and education levels, $p>0.05$) as shown in Table 1.

Table 1 Baseline characteristics

Characteristics	Aerobic group (n=16)	Control group (n=16)	p-value
Age, yrs	57.06 ± 6.8	54.5 ± 7.3	0.313
Sex, M/F	10/6	7/9	0.288
BMI, Kg/m²	28.5 ± 3.9	28.2 ± 3.7	0.825
Duration of CKD, yrs	3.4 ± 1.3	3.2 ± 1.5	0.689
Levels of education, n (%)			
Without recognized education	4 (25)	3 (18.75)	0.668
Primary to secondary school	8 (50)	7 (43.75)	0.723
Higher education or more	4 (25)	6 (37.5)	0.445

BMI: body mass index; CKD: chronic kidney disease

Clinical outcome measures also did not show statistical significance between the two groups pre-intervention (6-MWT, $p=0.609$, TUG-s, $p=0.533$, QOL-mental health, $p=0.687$, QOL-role functioning/emotional, $p=0.834$, HAM-DRS, $p=0.232$, and HAM-ARS, $p=0.703$) (Figure 2 and Table 2).

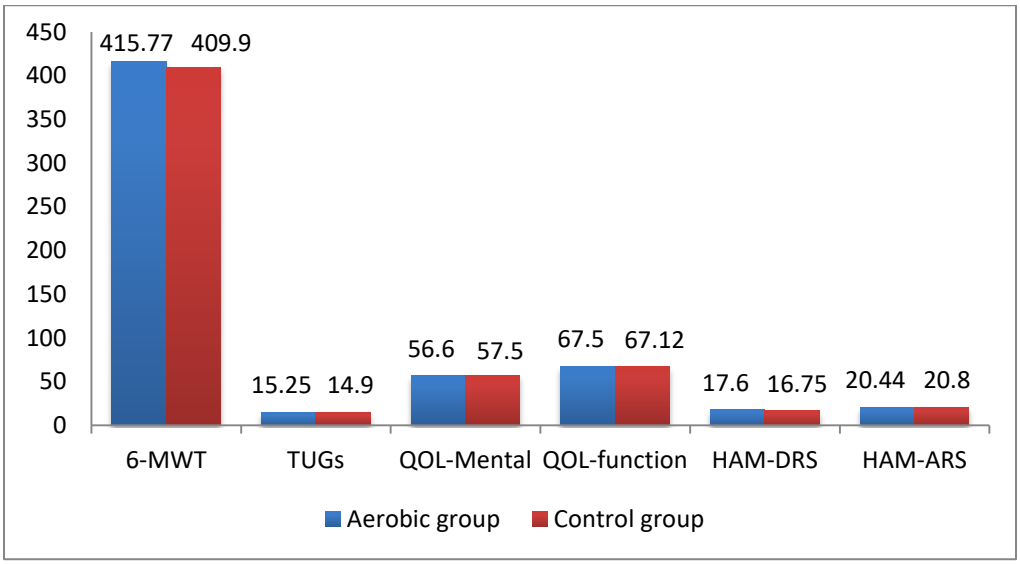

Figure 2 Clinical outcome measures between groups pre-intervention

Post-intervention, the aerobic group showed significant improvement in the outcome measures (6-MWT, $p=0.024$, TUG-s, $p<0.001$, QOL-mental health, $p=0.002$, QOL-role functioning/ emotional, $p=0.012$, HAM-DRS, $p<0.001$, and HAM-ARS, $p<0.001$), while, no significant changes were detected in the control group (6-MWT, $p=0.384$, TUG-s, $p=0.103$, QOL-mental health, $p=0.416$, QOL-role functioning/ emotional, $p=0.305$, HAM-DRS, $p=0.461$, and HAM-ARS, $p=0.157$) as described in Table 2. As displayed in Table 2, comparing between the aerobic and control groups showed a significant difference post-intervention (6-MWT, $p=0.025$, TUG-s, $p<0.004$, QOL-mental health, $p=0.022$, QOL-role functioning/ emotional, $p=0.013$, HAM-DRS, $p<0.001$, and HAM-ARS, $p<0.001$) in favor of aerobic group (Figure 3).

Table 2 Differences between Pre- and Post-intervention inter and intra-groups

Clinical outcomes	Aerobic group (n=16)	Control group (n=16)	*p*-value
6-MWT			
Pre-	415.77 ± 32.5	409.9 ± 31.8	0.609
Post-	438.7 ± 25.2	417.9 ± 24.7	0.025
p-value	0.024	0.384	
TUG-s			
Pre-	15.25 ± 1.3	14.9 ± 1.8	0.533
Post-	11.8 ± 0.7	13.7 ± 2.3	0.004
p-value	<0.001	0.103	
QOL-mental health			
Pre-	56.6 ± 6.4	57.5 ± 6.1	0.687
Post-	63.3 ± 5.6	58.9 ± 4.7	0.022
p-value	0.002	0.416	
QOL-role functioning/emotional			
Pre-	67.5 ± 6.3	67.12 ± 3.5	0.834
Post-	72.2 ± 3.6	68.5 ± 4.3	0.013
p-value	0.012	0.305	
HAM-DRS			
Pre-	17.6 ± 1.71	16.75 ± 2.2	0.232
Post-	11.75 ± 1.74	16.12 ± 2.9	<0.001
p-value	<0.001	0.461	
HAM-ARS			
Pre-	20.44 ± 2.6	20.8 ± 2.7	0.703
Post-	13.56 ± 2.8	19.6 ± 2.3	<0.001
p-value	<0.001	0.157	

Significant difference at p<0.05; 6-MWT: six-minute walk test; TUG-s: time up & go test; QOL: quality of life; HAM-DRS: Hamilton depression rating scale; HAM-ARS: Hamilton anxiety rating scale

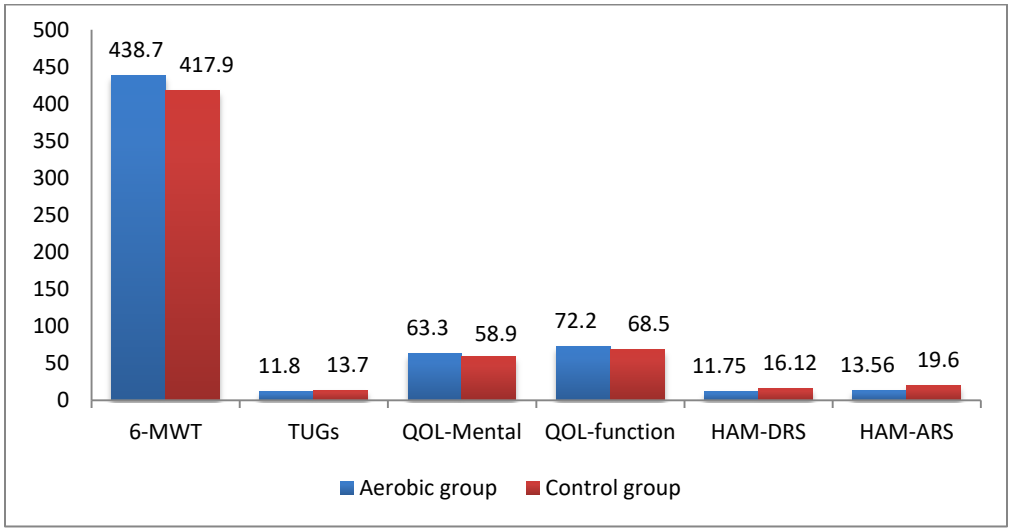

Figure 3 Post-intervention differences between groups

4. DISCUSSION

In The present study, patients with CKD were performed moderate-intensity aerobic exercise training; results revealed the aerobic exercises had positive effects on functional capacity, psychological status, and quality of life. The main findings were that aerobic

exercise program has been proved for improving physical capacity, psychological status, and quality of life in CKD patients. Indeed, the exercise program decreased the TUG-s total time and increased the total distance covered during 6MWT. Likewise, it had a beneficial effect on mental health; role functioning/emotional domains of the mental component of life quality assessed with SF36 questionnaire, also, there were improvements in the psychological status of these patients, which was measured by using the Hamilton depression and anxiety rating scale (HAM-ARS and HAM-DRS).

Previous studies had proved that preserving physical capacity and including exercise therapy in the management of CKD patients result in several benefits in addition to decreasing the disease's negative effects on functional capacity and life quality (Fernandes et al., 2019). Exercise training programs, involving aerobic training as a therapeutic intervention, could increase muscle strength, improve physical function, and quality of life in CKD patients (Watson et al., 2015). Previous studies examined the effectiveness of exercise training on physical function, and QOL in CKD patients (Bae et al., 2015; Headley et al., 2002; Painter et al., 2000; Parsons et al., 2006).

Regarding the measurement of physical capacity in CKD patients, it can be assessed by several types of tests. 6 MWT is one of the most important tests used in previous studies, because it is validated, easily applied, and inexpensive. In our study, 6 MWT was used with no difficulties (Solway et al., 2001). The baseline data of the mean 6MWT distance of the current study showed that there were no statistical differences detected between aerobic and control groups, After 10 week exercise period, the 6MWT distance was significantly improved in the AG compared with the CG, approved that the aerobic exercise program increased physical capacity in CKD patients, These results are going in hand with the study done by Bae et al. (2015) who observed that aerobic training for CKD patients was associated with improved physical performance and increased safe participation in physical activity. These findings were coherent with the study done by Parsons et al. (2006), which observed a significant improvement of physical capacity measured by 6MWT for CKD patients after 20 weeks of exercise training. Also, Reboredo et al. (2010) showed that aerobic exercise training performed for CKD patients, 6MWT distance increased significantly by 9% after three months of training.

The timed up and go (TUG) test is one of the most important tests of mobility, which is easy to conduct and can assess mobility, static balance, dynamic balance, lower extremities strength, and gait speed (Chun et al., 2017; Podsiadlo & Richardson, 1991; Roshanravan et al., 2013). The baseline data of (TUG) test in the present study, showed that there were no statistical differences detected between aerobic and control groups in the meantime, After 10 week exercise period, the (TUG) test time was significantly decreased in the AG compared with the CG, approved that the aerobic exercise program increased physical performance of CKD patients. These findings were coherent with the study done by Anding et al. (2015) which showed that exercise training program improves physical function significantly in CKD patients.

Regarding the quality of life measurement, we used mental component domains of medical outcomes study short-form 36-item which include two items mental health and Role functioning/emotional, the aerobic group showed significant improvement in the mental health and Role functioning/emotional, while, no significant changes were detected in the control group. These results agreed with the study done by Oh-Park et al. (2002) which evaluated Eighteen CKD patients with SF-36 for functional status. Their results proved that there was a significant improvement in the mental component scales (p= 0.004) of the CKD patients after the exercise training program. In contrast to our results Jamshidpour et al. (2020) did not observe any significant changes in life quality scales after eight weeks of exercise training of CKD patients. Also, the study was done by van Vilsteren et al. (2005) showed that CKD patients had lower quality of life, therefore were experiencing a poorer quality of life. Despite advances in the treatment of patients with CKD, many patients suffer from a high degree of anxiety and depression that can negatively affect their treatment (Navidian et al., 2006).

Regarding the psychological status assessment of patients with CKD, in the current study, we had used the Hamilton depression and anxiety rating scale; (HAM-ARS - HAM-DRS), results were shown that exercise therapy has a positive effect on depression and anxiety on CKD patients, with statistically significant decreasing on depression and anxiety score after 10 weeks of moderate-intensity aerobic exercises program which wasn't observed in the control group. Our results agreed with the study done by Frih et al. (2017) that assessed CKD patients using the hospital psychosocial outcomes by Hospital Anxiety and Depression Scale (HADS). All parameters were significantly improved and higher in the exercise group than in the control group (Frih et al., 2017). Moreover, the study done by Amirtha Santhi et al. (2018), revealed that regular exercise program has decreased depression, anxiety, and stress in CKD patients, they were used Depression, Anxiety and Stress Scale (DASS 21) for assessment of their patients.

Tasci et al. (2019) investigated the impact of exercise on depression and anxiety treatment, they have used the Hamilton depression and anxiety rating scale; (HAM-ARS - HAM-DRS), their results proved the positive effect of exercise on depression treatment. Adams et al. (2015) revealed that aerobic exercises in MS patients led to moderate improvement in cognitive, depression, physical performance, balance, and fatigue levels.

Results of the current study suggest that conducting more qualitative and quantitative researches in this area is required to support the acceptance of physical exercise in the routine management of CKD patients and to improve the patient's quality of life, psychological status, and physical function.

5. CONCLUSION

Chronic kidney disease Patients has psychological and physical deterioration that leads to physical, social, and psychological complications, which will affect their lifestyle. Routine prescription of physical exercise is not a common practice, in which there is a shortage of scientific research and health services. However, ten weeks of an aerobic exercise program contributed to improving the patient's physical capacity, the emotional role of quality of life, and psychological health, therefore the current study show the important of such practice in clinical practice and the need for more research in the area to improve the clinical practice.

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Author's contribution

All authors conceptualized, designed, and carried out the study, collected and analyzed data. All authors read and agreed the final manuscript.

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Conflict of interest

The authors declare that there are no conflicts of interests.

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Ethical approval

The study was approved by the local institutional Ethics Committee of Department of Physical Therapy (RHPT/020/0063).

Data availability

Data included in the study are available from the corresponding author on request.

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